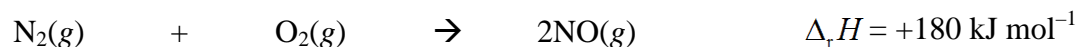
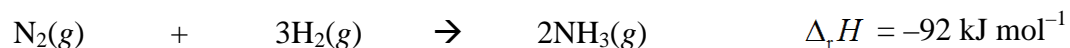


Hess's Law

1) Ammonia gas can be oxidised to produce nitrogen monoxide, NO, and water as shown in the equation below:



Calculate the enthalpy change, $\Delta_r H$, for this reaction using the information given below.



2) An equation for the combustion of octane is: $2\text{C}_8\text{H}_{18}(\ell) + 25\text{O}_2(g) \rightarrow 16\text{CO}_2(g) + 18\text{H}_2\text{O}(\ell)$ Calculate $\Delta_c H^\circ(\text{C}_8\text{H}_{18}(\ell))$, given the following data:

$$\Delta_f H^\circ(\text{C}_8\text{H}_{18}(\ell)) = -250 \text{ kJ mol}^{-1}$$

$$\Delta_f H^\circ(\text{CO}_2(g)) = -394 \text{ kJ mol}^{-1}$$

$$\Delta_f H^\circ(\text{H}_2\text{O}(\ell)) = -286 \text{ kJ mol}^{-1}$$

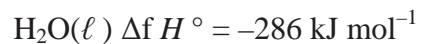
3) a) The equation for the combustion of ethanol is: $\text{C}_2\text{H}_5\text{OH}(\ell) + 3\text{O}_2(g) \rightarrow 2\text{CO}_2(g) + 3\text{H}_2\text{O}(\ell)$ Calculate $\Delta_c H^\circ(\text{C}_2\text{H}_5\text{OH}(\ell))$, given the following data:

$$\Delta_f H^\circ(\text{C}_2\text{H}_5\text{OH}(\ell)) = -277 \text{ kJ mol}^{-1}$$

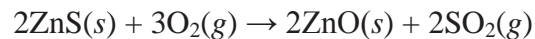
$$\Delta_f H^\circ(\text{CO}_2(g)) = -394 \text{ kJ mol}^{-1}$$

$$\Delta_f H^\circ(\text{H}_2\text{O}(\ell)) = -286 \text{ kJ mol}^{-1}$$

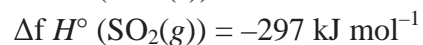
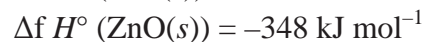
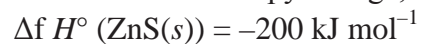
b) Use the information below to show that the $\Delta_c H^\circ$ of propene, $\text{CH}_2=\text{CHCH}_3(g)$, is $-2\,058\text{ kJ mol}^{-1}$.



4) Zinc oxide is formed when zinc sulfide is heated in air.

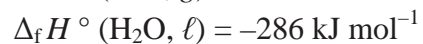
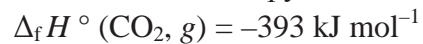


Calculate the enthalpy change, $\Delta_r H^\circ$, for this reaction, using the following data.



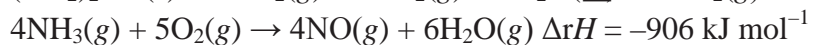
5) Carbon dioxide and water are formed when hexane burns in oxygen. $\text{C}_6\text{H}_{14}(\ell) + 9\frac{1}{2}\text{O}_2(g) \rightarrow 6\text{CO}_2(g) + 7\text{H}_2\text{O}(\ell) \quad \Delta_c H^\circ = -4163\text{ kJ mol}^{-1}$

Calculate the enthalpy of formation of hexane, $\Delta_f H^\circ(\text{C}_6\text{H}_{14}, \ell)$.

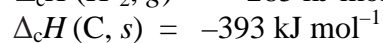
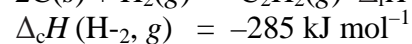
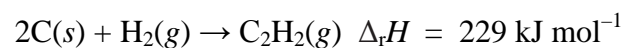


6) Urea breaks down in moist soil into carbon dioxide and ammonia. $(\text{NH}_2)_2\text{CO}(s) + \text{H}_2\text{O}(l) \rightarrow \text{CO}_2(g) + 2\text{NH}_3(g)$

Calculate the enthalpy change for this reaction, $\Delta_r H$, using the information below.



7) Calculate the heat of combustion of ethyne, $\Delta_c H$ $\text{C}_2\text{H}_2(g)$, from the following data:



8) Calculate $\Delta_f H(\text{C}_2\text{H}_5\text{OH}, l)$ using the following data.

